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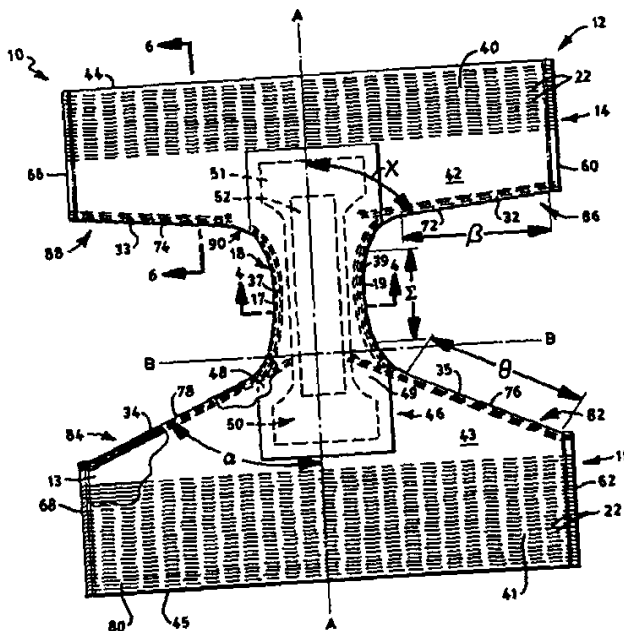
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(54) Title: DISPOSABLE UNDERPANTS

(57) Abstract

A three-dimensional disposable underpant having elasticized leg and waist openings and is stretchable about the hip and stomach regions of a user. The underpant includes an absorbent barrier composite positioned in the crotch area and extending into the body of the disposable underpant front and back portions to prevent liquid strike through onto outer clothing and bed linen.



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## **DISPOSABLE UNDERPANTS**

### **Field of the Invention**

5           This present invention relates to underpants in general, and more specifically to disposable incontinence underpants having a liquid impervious region and an absorbent layer to be used for incontinence protection.

### **Background of the Invention**

          Regular underpants in current use are made of cotton and/or synthetic materials. The cotton and synthetic panties typically do not offer barrier or absorbent protection. Often the synthetic panties have a cotton lined crotch to absorb perspiration or vaginal discharges. The  
15   absorbent/barrier properties of regular undergarments are minimal such that heavy perspiration, incontinence or any vaginal discharge may strike through onto outer clothing (i.e., penetration of liquid from the interior to the exterior of the underpant.)

          Cloth underpants used with other incontinence or absorbent articles, although widely-used,  
20   have disadvantages. Underpants with absorbent articles inserted can be uncomfortable to some users. Some users experience difficulty in maintaining the positioning of the absorbent article within the underpants, causing physical and psychological discomfort for the users and creating risks of leakage. In addition, if leakage should occur, the user must handle, and when in public, carry the wet underpants home.

25           Disposable training pants or disposable underpants used during the toilet training of small children, have been available for sometime. However, due to the differences between small children and adult bodies as well as the different activities and movements of small children and adults, simply increasing the size of disposable training pants to adult sizes may not meet many of  
30   the needs of adult users.

Many of the disposable underpants currently available or disclosed include garments having elastic members sandwiched between a liquid permeable topsheet and a liquid impermeable backsheet and extending substantially over the width of an absorbent core or slightly beyond the absorbent core, such that the elastic members, particularly those associated with said respective leg-holes which are important to prevent leakage around the crotch. However, such a structure can cause a rigidity of the absorbent core, bunching of the absorbent core, or gaps in the elastic structures that can result in leakage as well as an uncomfortable fit. Other disposable underpants include a weld in the crotch region joining the front and rear panels which can also cause a rigidity that results in leakage as well as an uncomfortable fit, especially where the weld comes into contact with the user's skin.

Other disposable underpants disclose various side seal designs, varying from interior and exterior side seals. The garments including interior side seals, while having an improved appearance, can result in skin irritation. Such garments currently require complex and expensive manufacturing steps. The garments including exterior side seals provide a more comfortable fit in the side regions but do not meet the need for a garment having comfortably fitting leg and crotch elastic members and improved leakage that are easily manufactured.

Disposable diaper-like garments, as is well known, now find widespread use for adult incontinence care, as well as for infant care. The typical disposable diaper-like garment is a three-layer composite structure comprising a liquid permeable bodyside inner liner, a liquid impermeable outer cover and an absorbent batt sandwiched between the liner and the cover. Materials now in general use for the three principal elements of the disposable diaper-like garment include various types of nonwoven fabrics for the bodyside liner, a thin thermoplastic film for the outer cover and cellulosic fluff for the absorbent batt.

Disposable diaper-like garments of the type presently on the market are flat open-sided garments that are intended to be fit about a user's body. The rear panel of the diaper-like garment is placed over the user's buttocks while the front panel of the garment covers the user's abdomen. The sides of the garment are overlapped and held together by various fastening means such as pressure-sensitive adhesive tape.

The popularity of such disposable diaper-like garments has led to a demand for a disposable underpant for children and the belief that there is a demand for a disposable underpant that can be used for adult incontinence. While disposable diaper-like garments are available for incontinent persons, there are many reasons as to why such garments do not meet the needs or desires of users. The application of the diaper-like garments is typically much more difficult, requiring more coordination and more steps than simply pulling up a pair of underpants. The

appearance of the diaper-like garments has a psychological effect on users, including feelings of loss and embarrassment.

5           Incontinence and feminine care sanitary napkins or pads used with regular underpants typically have polyethylene backings that provide some barrier properties needed to prevent liquid strike through. However, if the strike through extends to the sides or the ends of the pads it can leak onto the underpants. This leakage can wet the underpant. Depending upon the amount of leakage, liquid may strike through or go around the undergarment to the outer clothing and/or bedding. Individuals having heavy incontinence problems often use one or more pads at a time  
10       and change the pads frequently to prevent embarrassing, messy leakage. In some cases, individuals experiencing heavy incontinence will restrict their activities and stay home.

          Placement of incontinence and feminine pads in the crotch of regular underpant shows that, at best, the pads lay on the leg elastic and, at worst, overhang the leg elastics. This causes side  
15       leakage onto the underpant and possibly onto outer clothing. Typical leakage from the pads is caused by poor fit of the absorbent pad to the body, improper positioning of the pad by the user and lack of absorbency. Leakage from the underpant onto the outer clothing is due to incompatibility between the absorbent pad width and the underpant crotch width and lack of barrier properties in the underpant material around the edge portion of the absorbent pad. In addition,  
20       leakage frequently results from the shifting of the absorbent pad during use because of ineffective placement or securement to regular underpants.

## 25       Summary Of The Invention

          Briefly, this invention describes a three dimensional, disposable, discrete underpant with elasticized leg openings and waist portion that is circumferentially stretchable about the hip and stomach regions and which provides incontinence protection.

30           The protection benefit is obtained by providing a flexible absorbent core associated with the crotch area of the underpant wherein the absorbent core is maintained in proper location for incontinence discharge by an elastic system surrounding each leg opening. The absorbent core extends from the crotch area of the underpant into the body of the underpant in front and back  
35       body portions. This provides an underpant which is capable of trapping and absorbing the incontinence discharge and preventing liquid strike through onto outer clothing and bed linen.

**Brief Description Of The Drawings**

- 5           The present invention will be more fully understood and further advantages will become apparent when reference is made to the following detailed description of the invention and the drawings, in which:
- 10           **Figure 1a** is a top plan view of a underpant article of the present invention in a preassembled flat configuration;
- Figure 1b** is a top plan view of a underpant article of the present invention in a preassembled flat configuration;
- 15           **Figure 1c** is a top plan view of a underpant article of the present invention in a preassembled flat configuration;
- Figure 2a** is a top plan view of a underpant article of the present invention in a preassembled flat configuration;
- 20           **Figure 2b** is a top plan view of a underpant article of the present invention in a preassembled flat configuration;
- Figure 3** is a top plan view of a underpant article of the present invention in a preassembled flat configuration;
- 25           **Figure 4** is a perspective view of a full-sized, disposable underpant of the present invention.
- Figure 5** is a perspective view of a full-sized, disposable underpant of the present invention.
- 30           **Figure 6** is a sectioned view taken along view lines 6-6 of **Figure 1a** and illustrating the outer cover, liner and elastics.
- Figure 7** is a sectioned view taken along view lines 6-6 of **Figure 2b** and illustrating the outer cover, liner and elastics.
- 35           **Figure 8** is an exploded sectioned view taken along view lines 4-4 of **Figure 1a** and illustrating the absorbent layer, barrier and outer cover.

Figure 9 is an exploded sectioned view taken along view lines 4-4 of Figure 2a and illustrating the absorbent layer, barrier and outer cover.

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#### Detailed Description of the Preferred Embodiments

The following detailed description is made in the context of an article 10 including a disposable underpant 12 including an absorbent core in place during use. It is readily apparent, however, that the present invention can be employed for incontinence, vaginal, perspiration discharges, and the like in adult, child and infant products.

The disposable underpant 12 of Figure 1a illustrates the preferred embodiment of the present invention in a flat configuration prior to assembly. In Figure 1a, the underpant 12 is shown having an outer cover 13 which includes a front body portion 14, a back body portion 15, a front waist edge portion 44, a back waist edge portion 45, a crotch portion 18, waist liner 26 (optional, shown in Figures 5 and 7), leg liner 38 (optional, shown Figures 5 and 7) and body liner 80. The outer cover 13 may include a front body portion 14, a back body portion 15, a front waist edge portion 44, a back waist edge portion 45, and a crotch portion 18 wherein the crotch portion 18 is interposed between the front and back body portions 14 and 15.

The outer cover 13 is compliant and soft feeling to the wearer. The outer cover 13 may be any soft, flexible, porous sheet which is liquid pervious, permitting liquids to readily penetrate into its thickness, or impervious, resistant to the penetration of liquids into its thickness. A suitable outer cover 13 may be manufactured from a wide range of materials, such as natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polyester or polypropylene fibers) or from a combination of natural and synthetic fibers or reticulated foams and apertured plastic films.

There are a number of manufacturing techniques which may be used to manufacture the outer cover 13. For example, the outer cover 13 may be woven or nonwoven web or sheet such as a spunbond, meltblown or bonded-carded web composed of synthetic polymer filaments, such as polypropylene, polyethylene, polyesters or the like, or a web of natural polymer filaments such as rayon or cotton. The bonded-carded web may be thermally bonded or sprayed with a binder by means well known to those skilled in the fabric art. Suitably, the outer cover 13 is a nonwoven spunbond. Ideally, the outer cover 13 is a spunbond polypropylene nonwoven with a wireweave bond pattern. Suitably, the spunbond material is available from Kimberly-Clark Corporation, located in Roswell, GA. The outer cover 13 has a weight from about 0.3 oz. per square yard (osy) to about 2.0 osy and alternatively about 0.6 osy. The outer cover 13 of the underpant maybe

printed, colored or decoratively embossed. The outer cover 13 has a pore size that readily allows the passage therethrough of air, sweat, perspiration due to the breathability of the material. The outer cover 13 may be selectively embossed or perforated with discrete slits or holes extending therethrough.

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Referring to Figures 1a, 2a, and 3, an edge 60 of front body portion 14 is assembled with an edge 62 of the back body portion 15 to form a seal or side seam 64. Similarly, an edge 66 of the front body portion 14 is assembled with an edge 68 of the back body portion 15 to form a seal or side seam 70. The front body portion 14 and the back body portion 15, when assembled form a waist opening 20 for putting on and taking off the underpant 12. The waist opening 20 is surrounded at least in part by waist portion elastic 22 including from between 1 and 40 elastic strands, threads, ribbons, or bands of elastic material. The waist portion elastic 22 is stretched and attached to the body portions 14 and 15. The waist portion elastic 22 may also be placed in the front and back waist edge portions 44 and 45. (In other embodiments, the waist portion elastic 22 may be contained only in the front body portion 14 or only in the back body portion 15). The waist portion elastic 22 are released after attachment to produce waist portion folds, gathers, or pleats 24 (shown in Figures 4 and 5) to allow expansion of the waist opening 20 and the body portions 14 and 15 so that the underpant 12 can fit various sized individuals.

Because users of this invention generally prefer a brief style underpant, the front waist edge portion 44 of the underpant 12 preferably comes to the navel and even around the wearer's waist. Having the underpant 12 at this height and then drawing in either or both waist portions 14 and 15 with the waist portion elastic 22 provides a snug fit. Alternative underpant styles may include bikini (e.g. regular leg cut and french leg cut) and hipster (e.g. regular leg cut or french leg cut).

25

In some embodiments, the waist opening 20 is surrounded by waist elastic 21 including at between 1 and 10 strands, ribbons, or bands of elastic materials that are stretched and attached to the front waist edge portion 44 and/or the back waist edge portion 45. (See Figures 5 and 7.) (In other embodiments, the waist elastic 21 may be contained only in the front waist edge portion 44 or in the back waist edge portion 45.) The waist elastic 21 is released after attachment to produce waist folds, gathers, or pleats 25 to allow expansion of the waist opening 20 so that the underpant 12 can fit various sized individuals. Using waist elastic 21 having a different tension or elongation than the tension or elongation used in the waist portion elastic 22 can provide a better fitting underpant 12.

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Referring again to Figure 1a, the front body portion 14 and the back body portion 15 together with the crotch portion 18 forms leg openings 28 and 30, respectively, which are generally



circular or oval in shape. The leg openings 28 and 30 are each surrounded at least in part by leg elastics 32, 33, 34, and 35, respectively. The front leg elastics 32 and 33 are stretched and attached to the front body portion 14, back leg elastics 34 and 35 are stretched and attached to the back body portion 15 and the crotch elastics 37 and 39 are stretched and attached to the crotch portion 18. The leg and crotch elastics 32, 33, 34, 35, 37, and 39 are released after attachment to produce leg gathers (also referred to as folds or pleats) 36 to allow expansion of the leg openings 28 and 30 to fit various sized legs.

The front body portion 14 is usually divided into a front upper body portion 40 and a front lower body portion 42. (See Figures 1a, 2a, and 3.) Similarly, the back body portion 15 is divided into a back upper body portion 41 and a back lower body portion 43. The front and back upper body portions 40 and 41 are preferably designed to include waist portion elastic 22 which is capable of stretching to allow the wearer to put on the underpant 12 and then readily contracting and conforming to the wearer's body. This ensures a close or snug fit to different body shapes and sizes. The waist portion elastic 22 is positioned on both the front and the back upper body portions 40 and 41, respectively, at positions between the waist opening 20 and the leg openings 28 and 30, so that the underpant 12 fits the wearer better, particularly around the body. The front and back lower body portions 42 and 43 do not necessarily require waist portion elastic 22. The basis weight of the laminate comprising the outer cover 13, the bodyside liner 80, and waist portion elastic 22 may be as high as 5 osy.

The crotch portion 18 of the underpant 12 consists of an absorbent barrier composite 46. (See Figure 1a.) The absorbent barrier composite 46 further consists of a liquid barrier 48, a substantially liquid pervious topsheet layer 49, and an absorbent core 50 sandwiched between the liquid barrier 48 and the topsheet layer 49. The liquid barrier 48 and the topsheet layer 49 are desirably longer and wider than the absorbent core 50, so that the peripheries of the liquid barrier 48 and the topsheet layer 49 form margins which may be sealed together using ultrasonic bonds, thermal bonds, adhesives, or other suitable means. In this sealed area, the crotch elastics 37 and 39 may be incorporated between the liquid barrier 48 and the topsheet layer 49. The absorbent core 50 may be attached to the liquid barrier 48 and/or the topsheet layer 49 using ultrasonic bonds, adhesives, or other suitable means. (See Figures 1a, 8, and 9.)

The absorbent barrier composite 46 may also include additional components to assist in the acquisition, distribution, and storage of body exudates. For example, the absorbent barrier composite 46 may include a transport layer, such as described in U.S. Patent 4,798,603 issued January 17, 1989, to Meyer et al., or a surge management layer, such as described in European Patent Application EP 0 539 703 A1, published May 5, 1993, which patent and application are

incorporated herein by reference. Such layers are also referred to as acquisition/distribution layers.

5 The absorbent barrier composite 46 can be constructed by supplying topsheet layer 49 and liquid barrier 48 materials and sandwiching an individual absorbent core 50 between the liquid barrier 48 and the topsheet layer 49. The side and end peripheries of the liquid barrier 48 and the topsheet layer 49 outward of the absorbent core 50 can be joined with the crotch portion 18, the front body portion 14, and the back body portion 15 and sealed together. The absorbent barrier composite 46 may optionally be T-shaped, I-shaped, oval-shaped, hourglass-shaped, rectangular-  
10 shaped, or irregularly-shaped.

The absorbent core 50 can comprise a coform material composed of a mixture of cellulosic fibers and synthetic polymer fibers. For example, the coform material may comprise an airlaid blend of cellulosic wood fibers and meltblown polyolefin fibers, such as polyethylene or  
15 polypropylene fibers. Absorbent core 50 can comprise only coform, a combination of superabsorbent materials and coform, coform with other absorbent or non-absorbent materials including an acquisition/distribution layer, or any combination thereof.

The coform material may comprise an airlaid blend of cellulosic wood fibers and meltblown  
20 polyolefin fibers, such as polyethylene or polypropylene fibers, or may comprise an air-formed batt of cellulosic fibers (i.e., wood pulp fluff). Optionally, the absorbent core 50 may be treated with a surfactant to aid in liquid acquisition when in a dry environment. In particular embodiments of the invention, the absorbent core 50 has a bulk thickness of not more than about 40 mm when dry. The hydrophilic fibers and polymer strands may be provided in a fiber-to-polymer ratio which is  
25 greater than 20:80, for example between about 60:40 and about 98:2 and, desirably between about 80:20 and about 90:10. In coform material containing super absorbent materials, the fiber/high absorbency material ratio is between about 90:10 to about 50:50, and desirably between about 60:40 to about 65:35. High absorbency materials are discussed below.

30 Organic high-absorbency materials can include natural materials, such as pectin, guar gum and peat moss, as well as synthetic materials, such as synthetic hydrogel polymers. Such hydrogel polymers may include, for example, carboxymethylcellulose, alkali metal salts of polyacrylic acids, polyacrylamides, polyvinyl alcohol, ethylene maleic anhydride copolymers, polyvinyl ethers, hydroxypropyl cellulose, polyvinyl morpholinone, polymers and copolymers of  
35 vinyl sulfonic acid, polyacrylates, polyacrylamides, polyvinyl pyridine or the like. Other suitable polymers can include hydrolyzed acrylonitrile grafted starch, acrylic acid grafted starch, and isobutylene maleic anhydride copolymers, and mixtures thereof.

The hydrogel polymers are desirably sufficiently cross-linked to render the materials substantially water-insoluble. Cross-linking may, for example, be by irradiation or by covalent, ionic, van der Waals or hydrogen bonding. Suitable materials are available from various commercial vendors, such as Dow Chemical Company, Hoechst-Celanese Corporation and Allied-Colloid. Typically, the high-absorbency material is capable of absorbing at least about 15 times its weight in water, and desirably is capable of absorbing more than about 25 times its weight in water.

The high-absorbency material can be distributed or otherwise incorporated into the absorbent core 50 employing various techniques. For example, the high-absorbency material can be substantially uniformly distributed among the fibers comprising the absorbent core 50. The materials can also be non-uniformly distributed within the absorbent core 50 fibers to form a generally continuous gradient with either an increasing or decreasing concentration of high-absorbency material, as determined by observing the concentration moving inward from the liquid barrier 48. Alternatively, the high-absorbency material can comprise a discrete layer separate from the fibrous material of the absorbent core 50, or can comprise a discrete layer integral with the absorbent core 50.

The absorbent core 50 may also include a wrap layer 100 to help maintain the integrity of the fibrous core. (See Figures 8 and 9.) This wrap layer 100 may comprise a cellulosic tissue or spunbond, meltblown or bonded-carded web material composed of synthetic polymer filaments, such as polypropylene, polyethylene, polyesters or the like or natural polymer filaments such as rayon or cotton.

Preferably, the thickness of the absorbent core 50 is less than about 45 mm. The thickness of the absorbent core 50 may range from about 4 mm to about 40 mm. Preferably, the thickness ranges from about 5 mm to about 30 mm with a thickness having a most preferred range from about 6 mm to about 20 mm. The thickness is measured on a 4 inch (102 mm) smooth unbuckled square sample (elastics removed) with a Mitutoyo Digamatic Indicator using a 3 inch (76 mm) diameter acrylic platen and assembly to produce a pressure of 0.05 psi.

The absorbent core 50 should have a liquid capacity great enough to absorb discharges from about 100 grams to about 1500 grams. The absorbent core 50 should preferably have a capacity (described below) and a thickness preferably less than about 25 mm, thus providing a non-bulky and flexible fit. The capacity of the absorbent core 50 should have a total capacity of about 200 grams to about 1000 grams. Preferably, the absorbent core 50 should have a total capacity of at least about 300 grams and not more than about 800 grams. More preferably, the total capacity of the absorbent core 50 should be from about 400 grams to about 600 grams.

The total capacity of the absorbent core 50 is determined using the absorbent barrier composite 46 of the underpant 12 and the outer cover 13. The saturated retention capacity is a measure of the total absorbent capacity of an absorbent garment, in this case underpant 12. The saturated retention capacity is determined as follows. The underpant 12 to be tested, having a  
5 moisture content of less than about 7 weight percent, is then weighed and submerged in an excess quantity of the room temperature (about 23° C) saline solution described below. The material is allowed to remain submerged for 20 minutes. After 20 minutes the underpant 12 is removed from the saline solution and placed on a Teflon™ coated fiberglass screen having 0.25 inch openings (commercially available from Taconic Plastics Inc., Petersburg, N.Y.) which, in turn, is placed on a  
10 vacuum box and covered with a flexible rubber dam material. A vacuum of 3.5 kilopascals (0.5 pounds per square inch) is drawn in the vacuum box for a period of 5 minutes. The underpant 12 is weighed. The amount of fluid retained by the material being tested is determined by subtracting the dry weight of the underpant 12 from the wet weight of the underpant 12 (after application of the vacuum) and is reported as the saturated retention capacity in grams of fluid retained.

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The saline solution is a solution of about 0.9 percent sodium chloride by weight. A suitable product is S/P™ Certified Blood Saline commercially available from Baxter Diagnostics in McGaw Park, Illinois.

20 In construction of the absorbent barrier composite 46, the liquid barrier 48 should retard the movement of the liquid through the absorbent barrier composite 46 by making the liquid barrier 48 resistant to penetration normally encountered under wearing conditions. The absorbent barrier composite 46 may be rendered liquid impermeable by any method well known in the art such as coating the absorbent core 50 or by securing a separate liquid impermeable material to the  
25 absorbent core 50. The liquid barrier 48 may comprise a thin, liquid impervious web or sheet of plastic film such as polyethylene, polypropylene, polyvinyl chloride or similar material. Alternately, the liquid barrier 48 may comprise a nonwoven, fibrous web which has been suitably constructed and arranged to have low liquid perviousness. Still alternately, the liquid barrier 48 may comprise a layered or laminated material, such as a thermally bonded plastic film and nonwoven web  
30 composite. Alternatively, the liquid barrier 48 consists of a liquid impervious film or foam which is pervious to water vapor under normal wearing conditions. More preferred, the liquid barrier 48 has a water vapor transmission rate of at least about 1000 grams/m<sup>2</sup>/day measured by ASTM E98-92. One example of a suitable film is a 39.4 grams per square meter microporous film produced by Mitsui and sold by Consolidated Thermoplastics (CT) under the tradename of ESPOIR® N-TAF-  
35 CT.

The liquid barrier 48 desirably comprises a material that is formed or treated to be fluid impermeable. Alternatively, the liquid barrier 48 may comprise a fluid permeable material and

other suitable means (not shown), such as a fluid impermeable layer associated with the absorbent barrier composite 46 (or the absorbent core 50), may be provided to impede fluid movement away from the absorbent barrier composite 46 (or the absorbent core 50). The liquid barrier 48 may comprise a single layer of material or a laminate of two or more separate layers of material.

- 5     Suitable materials for the liquid barrier 48 include thermoplastic films, wovens, nonwovens, laminates of films, wovens, and/or nonwovens, foams, or the like. For example, the liquid barrier 48 may comprise a thin, substantially fluid impermeable web or sheet of plastic film such as polyethylene, polypropylene, or similar material. One suitable material for the liquid barrier 48 is a 0.028 millimeter (mm) thick polyethylene film with a systematic matte embossed pattern and that
- 10    has been corona treated on both sides. The terms "fluid impermeable" or "liquid impermeable" as used herein to describe a layer or laminate means that fluid or liquid such as urine will not pass through the layer or laminate under ordinary use conditions in a direction generally perpendicular to the plane of the layer or laminate at the point of fluid (or liquid) contact.

- 15         The liquid barrier 48 is needed to prevent liquid strike through to the outer clothing when discharge occurs onto the absorbent barrier composite 46 of the underpant 12. The liquid barrier 48 is located on the inside of the outer cover 13 in the crotch portion 18 and consists of a liquid impervious film such as polyethylene. Use of only the film (without the outer cover 13) would be hot and uncomfortable, may not be durable enough to withstand extended periods of wear. The
- 20    absorbent core 50 may be associated with a liquid barrier 48 which may or may not include elastic characteristics.

- The absorbent barrier composite 46 includes a substantially fluid impermeable liquid barrier 48, a fluid (or liquid) permeable topsheet layer 49 superposed on the outer cover 13. (See Figures
- 25    1a, 8, and 9.) The absorbent core 50 is sandwiched between the liquid barrier 48 and the topsheet layer 49. (See Figures 1a, 8, and 9.) The liquid barrier 48 and the topsheet layer 49 are desirably longer and wider than the absorbent core 50. The topsheet layer 49 is designed to be positioned toward the wearer and is referred to as the body-facing surface 16. Conversely, the liquid barrier 48 is designed to be positioned toward the outer cover 13 and the outer clothing of the wearer and
- 30    is referred to as the garment-facing surface 23.

- The absorbent core 50 comprises materials adapted to absorb and retain urine, menses, blood, or other body excrement. The absorbent core 50 may comprise various natural or synthetic absorbent materials, such as cellulose fibers, surfactant treated meltblown fibers, wood pulp fibers,
- 35    regenerated cellulose or cotton fibers, a blend of pulp and other fiber, or the like. One such material is a coform material which is composed of a mixture of cellulosic fibers and synthetic polymer fibers. The absorbent core 50 may also include compounds to increase its absorbency, such as 0 - 95 weight percent of organic or inorganic high-absorbency materials, which are

typically capable of absorbing at least about 15 and desirably more than 25 times their weight in water. Suitable high-absorbency materials are described in U.S. Patents 4,699,823 issued October 13, 1987, to Kellenberger et al. and 5,147,343 issued September 15, 1992 to Kellenberger, which are incorporated herein by reference. High absorbency materials are available from various commercial vendors, such as Dow Chemical Company, Hoechst Celanese Corporation, and Allied Colloids, Inc. The absorbent core 50 may also include tissue layers or acquisition or distribution layers to help maintain the integrity of fibrous absorbents or transport fluids.

One suitable absorbent core 50 is separately illustrated in Figure 8 and comprises a fluid storage layer 51 and an acquisition/distribution layer 52. The fluid storage layer 51 has two sections. The 1st section, the acquisition section (not shown), has a greater fluid capacity per unit area with 479 GSM fluff and 260 GSM SAP. The acquisition section is centered in the area where urine will be insulated by the user. The second section (not shown) has lower capacity per unit area, 215 GSM fluff and 117 GSM SAP.

The acquisition/distribution layer 52 is disposed on the fluid storage layer 51 toward the body-facing surface 16 of the absorbent core 50 to help decelerate and diffuse surges of fluid that may be introduced into the absorbent core 50. The acquisition/distribution layer 52 may comprise a through-air bonded carded web composed of a blend of 40 percent 6 denier polyester fibers, commercially available from Hoechst Celanese Corporation, and 60 percent 3 denier polypropylene/polyethylene sheath core bicomponent fibers, commercially available from the Chisso Corporation, with an overall basis weight ranging of from about 50 gsm and about 120 gsm. Alternative acquisition/distribution materials are described in U.S. Patent 5,192,606 issued March 9, 1993, to D. Proxmire et al.; U.S. Patent 5,486,166 issued January 23, 1996 to Ellis et al.; U.S. Patent 5,490,846 issued February 13, 1996 to Ellis et al.; and U.S. Patent 5,509,915 issued April 23, 1996 to Hanson et al.; the disclosures of which are hereby incorporated by reference. The illustrated acquisition/distribution layer 52 is rectangular with a length of about 191 mm. And a width of about 45 mm. The acquisition/distribution layer 52 can vary in shape and size as disclosed for the absorbent core 50 and the absorbent barrier composite 46.

In other embodiments of the present invention, the absorbent barrier composite 46 includes a single layer absorbent core 50. The absorbent core 50 comprises materials adapted to absorb and retain urine, menses, blood or other body excrement. The absorbent core 50 may comprise various natural or synthetic absorbent materials, such as cellulose fibers, surfactant treated meltblown fibers, wood pulp fibers, regenerated cellulose or cotton fibers, a blend of pulp and other fibers, or the like. One such material is coform material which is composed of a mixture of cellulosic fibers and synthetic polymer fibers. The absorbent core 50 may also include compounds to increase its absorbency, such as 0 - 95 weight percent of organic or inorganic high-absorbency

materials, which are typically capable of absorbing at least about 15 and desirably more than 25 times their weight in water. Suitable high-absorbency materials are described in U.S. Patents 4,699,823 issued October 13, 1987, to Kellenberger et al.; and 5,147,343 issued September 15, 1992, to Kellenberger, which are incorporated herein by reference. High-absorbency materials are available from various commercial vendors, such as Dow Chemical Company, Hoechst Celanese Corporation, and Allied Colloids, Inc.

One suitable absorbent core 50 for the underpant 12 is separately illustrated in Figure 9 and comprises a fluid storage layer 51. The fluid storage layer 51 comprises an air-laid mixture of about 470 gsm wood pulp fibers and about 305 gsm high-absorbency materials that is sandwiched or wrapped between 19 gsm cellulose tissues (wrap layers 100). The fluid storage layer 51 is desirably embossed using a matched male/male embossing roll. The typical absorbent core 50 is hourglass shaped with a length of between about 17 inches (430 mm) and about 21 inches (530 mm) and a width of between about 2.5 inches (64mm) and about 3.5 inches (120 mm). The absorbent core 50 desirably has a thickness dimension of less than about 20 mm, particularly less than about 10 mm.

The topsheet layer 49 is formed of a fluid permeable material so that fluid waste, and possibly semi-solid waste as well, can pass through to the absorbent core 50 and be absorbed by the absorbent barrier composite 46 (or absorbent core 50). A suitable topsheet layer 49 may be comprised a nonwoven web, a spunbond, meltblown or bonded-carded web composed of synthetic polymer filaments or fibers, such as polypropylene, polyethylene, polyesters or the like, a perforated film, or a web of natural polymer filaments or fibers such as rayon or cotton. In addition, the topsheet layer 49 may be treated with a surfactant to aid in fluid transfer. In one particular embodiment, the topsheet layer 49 comprises a nonwoven, spunbond web of sheath core bicomponent filaments with 50 percent polyethylene and 50 percent polypropylene having a basis weight of about 20 grams per square meter (gsm). The fabric is surface treated with a surfactant commercially available from Union Carbide Chemicals and Plastics Company, Inc., of Danbury, Connecticut, U.S.A. under the trade designation TRITON X-102. As used herein, the term "fabric" refers to all of the woven, knitted and nonwoven fibrous webs. The term "nonwoven web" means a web of material that is formed without the aid of a textile weaving or knitting process.

The width of the crotch portion 18 between the crotch elastics 37 and 39 should be wide enough to accommodate the absorbent core 50 between the side edges 17 and 19 of the crotch portion 18 without having the absorbent core 50 obstruct the crotch elastics 37 and 39 and ultimately the leg elastics 32, 33, 34, and 35. This allows the crotch elastics 37 and 39 to contract and draw up the sides of the crotch creating a bucket with walls of the topsheet layer 49 and liquid

barrier 48 to keep bodily exudates from leaking out of the product and to accommodate more sizes of individuals.

5 The width of the crotch portion 18 should not be so wide as to seem bulky or uncomfortable, but a suitable width is at least about 2.5 inches (64 mm) between the crotch elastics 37 and 39. The width is advantageously ranges from about 2.5 inches (64 mm) to about 6.0 inches (152 mm). Typically the width of the crotch portion 18 between the crotch elastics 37 and 39 ranges from about 3.5 inches (89 mm) to about 5 inches (127 mm). Preferably, the width so defined is about 4.25 inches (108 mm).

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The crotch portion 18 is at least about 0.25 inch (6 mm) wider than the width of the absorbent core 50. The crotch portion 18 is from about 0.25 inch (6 mm) to about 4 inches (102 mm) wider than the absorbent core 50. Typically the crotch portion 18 is from about 0.5 inch (13 mm) to about 3 inches (76 mm) wider than the absorbent core 50 and more typically from about 15 0.5 inch (13 mm) to about 2 inches (51 mm) wider. Preferably, each of the crotch elastics 37 and 39 are from about 0.2 inch (5 mm) to about 0.8 inch (20 mm) wide. More preferably, the width of each crotch elastics 37 and 39 is from about 0.2 inch (5 mm) to about 0.4 (10 mm). The overall width of the crotch portion 18 includes the width between the crotch elastics 37 and 39, the width of the crotch elastics 37 and 39 and the ruffle material outside the crotch elastics 37 and 39 to the 20 edge of the leg openings 28 and 30.

Preferably, ruffle material on the edge of the leg openings 28 and 30 outside the leg and crotch elastics 32, 33, 34, 35, 37, and 39 is less than about 0.5 inch (13 mm). More preferably, the ruffle material is less than about 0.125 inch (3 mm). It is most desirable to eliminate the ruffle 25 material from the edge of the leg openings 28 and 30.

The width of the absorbent barrier composite 46 is sized in relation to the width of the crotch portion 18. The width of the composite 46 is at least the width of the crotch portion 18 between the crotch elastics 37 and 39. Preferably, the width is equivalent to the width of the crotch portion 18.

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The overall length of the absorbent barrier composite 46 should be adequate to extend beyond the ends of the absorbent core 50 to help prevent liquid strike through at these points when sleeping or sitting. This overall length is at least about 12 inches (305 mm) thus extending beyond the crotch portion 18 along the longitudinal centerline A-A of the underpart 12. Alternatively, the 35 length should be in the range of about 12 inches (305 mm) to about 30 inches (762 mm), more typically ranging from about 15 inches (381 mm) to about 23 inches (584 mm). A common range is from about 17 inches (432 mm) to about 21 inches (533 mm) in length. Optimally, the length of the composite 46 is about 19 inches (483 mm).



The width of the absorbent barrier composite 46 extending beyond the crotch portion 18 should be at least as wide as the width of the crotch portion 18. The width of the absorbent barrier composite 46 could be narrowed beyond the crotch portion 18 but may compromise the leakage containment. Typically the width of the absorbent barrier composite 46 is widened beyond the crotch portion 18. The width of the absorbent barrier composite 46 extending beyond the crotch portion 18 is from about 2.5 inches (64 mm) to about 12 inches (305 mm), alternatively from about 4.0 inches (102 mm) to about 10 inches (254 mm). A common range is from about 7 inches (178 mm) to about 9 inches (229 mm). Optimally, the width is about 8 inches (203 mm).

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The present invention contemplates various shapes of the absorbent barrier composite 46. One preferred composite has a non-rectangular shape such as an hourglass or I-beamed shaped absorbent barrier composite 46 which provide extensive coverage in the seat of the finished underpant 12. Another preferred absorbent barrier composite 46 embodiment is rectangular in shape with rounded ends. The essentially rectangular-shaped absorbent barrier composite 46 (i.e. an hourglass shape) is more preferred since it can be squared off at the ends to provide a smoother appearance in the back of the underpant 12 while providing a more comfortable body-contouring fit.

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Referring to Figures 1a - c, 2a - b, 3, and 6, the waist portion elastic 22 are shown covered with a body liner 80. The body liner 80 consists of a nonwoven or other soft material for contacting the wearer's skin. The body liner 80 is described in more detail below. In other embodiments, at least a portion of the waist portion elastic 22 may be covered by the absorbent barrier composite 46. Referring to Figures 3 and 4, the leg elastics 32, 33, 34, and 35 are shown covered by the body liner 80. In Figure 1b, the crotch elastics 37 and 39 are shown sandwiched between the topsheet layer 49 and the liquid barrier 48. In alternative embodiments, the crotch elastics 37 and 39 can be sandwiched between the outer cover 13 and the liquid barrier 48. Depending on the size and shape of the absorbent barrier composite 46, at least a portion of the leg elastics 32, 33, 34, and 35 may be covered by the absorbent barrier composite 46.

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Referring to Figures 5 and 7, the waist elastic 21 are shown in another embodiment as covered with a waist liner 26. The waist elastic 21 could also be covered with the body liner 80. Referring to Figures 5 and 7, the leg elastics 32 and 34 are shown covered by a leg liner 38. Depending on the size and shape of the absorbent barrier composite 46, at least a portion of the leg elastics 32, 33, 34, and 35 may be covered by the absorbent barrier composite 46. In Figure 1a, the crotch elastics 37 and 39 are shown covered by the absorbent barrier composite 46 as the crotch elastics 37 and 39 are sandwiched between the outer cover 13 and the absorbent barrier composite 46. Referring to Figure 7, the waist portion elastic 22 are shown covered with a body

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liner 80. The body liner 80 consists of a nonwoven or other soft material for contacting the wearer's skin. In other embodiments, at least a portion of the waist portion elastic 22 may be covered by the absorbent barrier composite 46.

5           The body liner 80 is compliant and soft feeling to the wearer. The body liner 80 may be any soft, flexible, porous sheet which is liquid pervious, permitting liquids to readily penetrate into its thickness, or impervious, resistant to the penetration of liquids into its thickness. A suitable body liner 80 may be manufactured from a wide range of materials, such as natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polyester or polypropylene fibers) or from a combination of  
10       natural and synthetic fibers or reticulated foams and apertured plastic films.

          There are a number of manufacturing techniques which may be used to manufacture the body liner 80. For example, the body liner 80 may be woven or nonwoven web or sheet such as a spunbond, meltblown or bonded-carded web composed of synthetic polymer filaments, such as  
15       polypropylene, polyethylene, polyesters or the like, or a web of natural polymer filaments such as rayon or cotton. The bonded-carded web may be thermally bonded or sprayed with a binder by means well known to those skilled in the fabric art. Suitably, the body liner 80 is a nonwoven spunbond. Ideally, the body liner 80 is a spunbond polypropylene nonwoven with a wireweave bond pattern. Suitably, the spunbond material is available from Kimberly-Clark Corporation,  
20       located in Roswell, GA. The body liner 80 has a weight from about 0.3 oz. per square yard (osy) to about 2.0 osy and alternatively about 0.6 osy. The body liner 80 of the underpant maybe printed, colored or decoratively embossed. The body liner 80 has a pore size that readily allows the passage therethrough of air, sweat, perspiration due to the breathability of the material. The body liner 80 may be selectively embossed or perforated with discrete slits or holes extending  
25       therethrough.

          The position and the shape of the leg openings 28 and 30 are important to avoid tightness in the crotch and groin area of the wearer, to obtain adequate buttocks coverage, and to prevent the  
30       underpant 12 from tilting forward, i.e. tilting such that the front waist edge dips lower in relationship to the back waist edge. Figure 1a illustrates the most preferred design for leg fit and buttocks coverage. The shape of the curve across the front edges 72 and 74 of the leg openings 28 and 30 may have an impact on the fit of the underpant 12. If the curve is too deep, the underpant 12 will shift downward and backward resulting in a short front waist, increased back length and bagginess  
35       in the seat of the underpant 12. This causes the underpant 12 to appear tilted when worn as evidenced by an unevenness around the waist of the wearer, resulting in tightness along the front edges 72 and 74 of the leg openings 28 and 30 and reducing the comfort in the fit.

The structures of the leg openings 28 and 30 are important to the correct functioning of the underpant 12. With the underpant 12 laid out flat as in Figure 1a, the majority (at least 51%) of the back edges 76 and 78 of the back portions 82 and 84 of the leg openings 28 and 30 respectively preferably forms a substantially linear line. More preferably, the back edges 76 and 78 of the back portions 82 and 84 of the leg openings 28 and 30 are substantially linear for a length,  $\Theta$ , of at least about 70% of the length of the entire back portions 82 and 84. The straight section  $\Theta$  of the back edges 76 and 78 of the back portions 82 and 84 of the leg openings 28 and 30 should form an acute angle with the longitudinal centerline, A-A, of the underpant 12. Preferably, the line,  $\Theta$ , forms an angle,  $\alpha$ , with the centerline A-A of the underpant 12 of between about 45° and about 89°, more preferably between about 55° and about 87° and most preferably between about 61° and about 76°. If a shallow curve (a curve having a radius of at least 6 inches) defines the back edges 76 and 78 of the back portions 82 and 84 of the leg openings 28 and 30, two points are selected along the curve, one point is positioned at about 25% of length of the curve and the other point is positioned at about 75% of the length of the curve. A line drawn between the two points is used to determine the  $\alpha$  angle formed with the centerline A-A of the underpant 12. The back edges 76 and 78 forming acute angles with the longitudinal centerline as disclosed reduce bunching and shifting of the absorbent core 50 during use, ensuring a better contouring to the body and comfortable fit. Such angles help the underpant 12 to under cut the buttocks, improving fit and reducing leakage. It is understood that because the leg elastics 34 and 35 closely follow the back edges 78 and 76 respectively, the references to the back edges 78 and 76 can be read to describe the leg elastics 34 and 35.

The majority (at least 51%) of the front edges 72 and 74 of the front portions 86 and 88 of the leg openings 28 and 30 include lengths  $\beta$ , preferably forming straight lines. More preferably, the lengths of front edges 72 and 74 ( $\beta$ ) of the leg openings 28 and 30 are substantially linear for at least about 70% of the length of the front portions 86 and 88 of the leg openings 28 and 30. The substantially linear section  $\beta$  of the front edges 72 and 74 of the front portions of the leg openings 28 and 30 should form an angle  $\chi$  with the centerline of the underpant 12 of between about 62° and about 99°, more preferably between about 74° and about 91°, and most preferably about 85°. The front edges 72 and 74 forming an angle with the centerline as disclosed reduce bunching and shifting of the absorbent core 50 during use, ensuring a better contouring to the body and comfortable fit. If a shallow curve (a curve having a radius of at least 6 inches) defines the front edges 72 and 74 of the front portions 86 and 88 of the leg openings 28 and 30, two points are selected along the curve, one point is positioned at about 25% of length of the curve and the other point is positioned at about 75% of the length of the curve. A line drawn between the two points is used to determine the  $\chi$  angle formed with the centerline of the underpant 12. While front edges

72 and 74 forming angles of 90° can be used, angles at least slightly greater or less than 90° provide an underpant 12 having a comfortable fit during movement. It is understood that because the leg elastics 32 and 33 closely follow the front edges 72 and 74 respectively, the references to the front edges 72 and 74 can be read to describe the leg elastics 32 and 33.

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Likewise, the shape of the curve in the crotch portion 18 is important. The majority of the side edges 17 and 19 of the crotch portion 18 include lengths  $\Sigma$ , preferably forming curved (arcuate) lines. If the curve is too shallow or straight (especially at the ends of the crotch elastics 37 and 39), tightness may be experienced at the inner groin area and gapping in the fit of the underpant 12 as the underpant 12 does not follow the contour of the wearer's leg, resulting in leakage. The preferred narrow crotch width having shallow curves may also reduce the coverage of the buttocks. To compensate for such reduction, the back leg edges 76 and 78 on the back portions 82 and 84 are preferably adjusted downward, increasing the  $\alpha$  angle. The curve between the side edges 17 and 19 of the crotch portion 18 and the back portions 82 and 84 of the leg openings 28 and 30 should start slightly in front of centerline B-B of the underpant 12, see Figure 1a. This allows the back leg elastics 34 and 35 to be positioned below the lower edge of the buttocks and helps prevent the underpant 12 from riding up when walking. This means that the curved crotch portion  $\Sigma$  of the leg openings 28 and 30 are entirely forward of the underpant 12 centerline B-B. It is understood that because the crotch elastics 37 and 39 closely follow the edges 17 and 19 respectively, the references to the edges 17 and 19 can be read to describe the leg elastics 37 and 39.

While the leg elastics 32, 33, 34, and 35 can be designed to closely follow the edge of the absorbent core 50 outside of the crotch portion 18, moving the leg elastics 32, 33, 34, and 35 away from the absorbent core 50, the absorbent core 50 interferes less with the function of the leg elastics 32, 33, 34, and 35, providing better gasketing around the leg openings 28 and 30. In addition, as absorbent core 50 swells as it absorbs bodily discharges, the leg elastics 32, 33, 34, and 35 so positioned are better able to remain in contact with and conformed to the wearer's body.

In a preferred embodiment, the waist portion and leg elastics 22, 32, 33, 34, and 35, respectively, (and in embodiments including waist elastic 21) are attached to the underpant 12 sandwiched between the outer cover 13 and the body liner 80 in generally a stretched state by means known in the art, including ultrasonic bonded, heat/pressure bonded or adhesively bonded. The crotch elastics 37 and 39 are sandwiched between the liquid barrier 48 and the topsheet layer 49 of the absorbent barrier composite 46. The crotch elastics 37 and 39 are typically attached in a stretched state by means known in the art, including ultrasonic bonded, heat/pressure bonded or adhesively bonded. Materials suitable for the elastics include a wide variety including but not

limited to elastic strands, yarn rubber, flat rubber, elastic tape, film-type rubber, polyurethane and elastomeric, tape-like elastomeric or foam polyurethane or formed elastic or non-elastic scrim. Suitable material is sold under the name LYCRA® by the DuPont Company located in Wilmington, Delaware. Each elastic may be unitary, multi-part or composite in construction before integrating  
5 into the underpant 12.

In an alternative embodiment, the waist portion, leg, and crotch elastics 22, 32, 33, 34, 35, 37, and 39, respectively, (and in embodiments including waist elastic 21) are attached to the underpant 12 sandwiched between the outer cover 13 and the body liner 80 in generally a  
10 stretched state by means known in the art, such as ultrasonic bonded, heat/pressure bonded or adhesively bonded. Materials suitable for the elastics include a wide variety including but not limited to elastic strands, yarn rubber, flat rubber, elastic tape, film-type rubber, polyurethane and elastomeric, tape-like elastomeric or foam polyurethane or formed elastic or non-elastic scrim. Suitable material is sold under the name LYCRA® by the DuPont Company located in Wilmington,  
15 Delaware. Each elastic may be unitary, multi-part or composite in construction.

The portion of the front and back body portions 14 and 15 having waist portion elastic 22 is from about 1 inch (25 mm) to about 10 inches (254 mm) wide (perpendicular to A-A as shown in *Figure 1a*). More typically, the portion of the front and back body portions 14 and 15 having waist  
20 portion elastic 22 is from about 3 inches (76 mm) to about 8 inches (203 mm) wide. More typically, the width ranges from about 6 inches (152 mm) to about 7.5 inches (191 mm). In some embodiments it is desirable to vary the widths of waist portion elastic 22 between the front and back body portions 14 and 15. If one of the body portions 14 and 15 has a narrower portion of waist portion elastic 22, the width ranges between about 1 inch (25 mm) to about 8 inches (203  
25 mm), more typically from about 3 inches (76 mm) to about 6 inches (152 mm), and most typically from about 4 inches (102 mm) to about 5.5 inches (140 mm). The waist portion elastic 22 is applied under an elongation of from about 100% to about 400%, more typically under an elongation of from about 150% to about 300%, and most typically under an elongation of from about 200% to about 275%. The underpant 12 may be constructed such that the tension of the  
30 waist portion elastic 22 may be a different value in the front body portion 14 as compared to the tension of the waist portion elastic 22 in the back body portion 15.

The waist portion elastic 22 may comprise threads, strands, ribbons, bands, film, elastic nonwovens, or composite. The threads, strands, ribbons, or bands may be multiple and may be  
35 applied as a composite. The number of pieces of elastic material comprising the waist portion elastic 22 ranges from about 1 to about 100, more typically from about 10 to about 40, and most typically from about 15 to about 35. Preferably, when the waist portion elastic 22 are threads, 15 to 40 threads are used as the waist portion elastic 22 and the threads are spaced from about

0.0625 inch (1.6 mm) to about 2 inches (51 mm), more preferably from about 0.0625 inch (1.6 mm) to about 0.5 inch (13 mm), and most preferably about 0.25 inch (6 mm) apart. While the appearance of the underpant 12 may be enhanced by the close even spacing of the elastic material, such as threads, in the waist portion elastic 22, however, the distance between the pieces of elastic material can be varied. Such variation can be used in the front and back waist edge portions 44 and 45 to give the appearance of a waist band.

In a preferred embodiment, the elastic threads may be made of any suitable elastomeric material. One suitable material is spandex such as LYCRA® threads available from DuPont located in Wilmington, Delaware. Suitable waist portion elastic 22 include threads having a decitex (g/10000m) of about 100 to about 1200, more typically from about 470 to about 940, and most typically from about 620 to about 740 for waist portion elastic 22 comprising from about 15 to about 35 threads. Adhesive 74, typically applied in a meltblown or swirl pattern using currently known technology, is used to bond the waist portion elastic 22 to the outer cover 13 and the body liner 80. Preferably the adhesive 74 is applied only to the waist portion elastic 22. A suitable adhesive includes, for example, Findley H2096 hot melt adhesive which is available from Ato Findley Adhesives located in Milwaukee, WI.

In embodiments that include waist elastic 21, the waist elastic 21 is from about 0.0625 inch (1.6 mm) to about 2 inches (51 mm) wide. More typically, the front and back waist edge portions 44 and 45 of the front and back body portions 14 and 15 respectively having waist elastic 21 is from about 0.25 inches (6 mm) to about 1.5 inch (38 mm) wide. More typically, the width ranges from about 0.5 inches (13 mm) to about 1 inches (25 mm). The waist elastic 21 is applied under an elongation of from about 150% to about 300%, more typically under an elongation of from about 175% to about 275%, and most typically under an elongation of from about 200% to about 250%.

The waist elastic 21 may comprise threads, strands, ribbons, film, elastic nonwovens, or composite. The threads, strands, ribbons, or bands may be multiple and may be applied as a composite. The number of pieces of elastic material comprising the waist elastic 21 ranges from about 1 to about 20, more typically from about 2 to about 10, more typically from 2 to about 8, and most typically from about 2 to about 6. Preferably, when the waist elastic 21 are threads, 3 to 6 threads are used as the waist elastic 21 and the threads are spaced from about 0.0625 inch (1.6 mm) to about 1.5 inches (38 mm), more preferably from about 0.0625 inch (1.6 mm) to about 0.25 inch (6 mm), and most preferably about 0.125 inch (3 mm) apart.

The threads may be made of any suitable elastomeric material. One suitable material is spandex such as LYCRA® threads available from DuPont located in Wilmington, Delaware. Suitable waist elastic 21 include threads having a decitex (g/10000m) of from about 100 to about

1200, more typically from about 470 to about 940, and most typically from about 620 to about 940 for waist elastic 21 comprising from about 5 to about 10 threads. Adhesive 74, typically applied in a meltblown or swirl pattern using currently known technology, is used to bond the waist elastic 21 to the outer cover 13 and the body liner 80 or waist liner 26. Preferably the adhesive 74 is applied only to the waist elastic 21. A suitable adhesive includes, for example, Findley H2096 hot melt adhesive which is available from Ato Findley Adhesives located in Milwaukee, WI.

The leg elastics 32, 33, 34, and 35 are from about 0.0625 inch (1.6 mm) to about 1 inch (25 mm) wide, more typically from about 0.25 inch (6 mm) to about 1 inch (25 mm), and most typically from about 0.25 inch (6 mm) to about 0.75 inch (18 mm). The leg elastic 32, 33, 34, and 35 is applied under an elongation of from about 100% to about 300%, more typically under an elongation of from about 175% to about 275%, and most typically under an elongation of from about 200% to about 250%.

The leg elastics 32, 33, 34, and 35 may comprise threads, strands, bands, ribbons, film, elastic nonwovens, or composite. The threads, strands, ribbons, or bands may be multiple and may be applied as a composite. The number of pieces of elastic material comprising the leg elastic 32, 33, 34, and 35 ranges from about 1 to about 6, more typically from about 2 to about 5, and most typically from about 3 to about 4. Preferably, when the leg elastic 32, 33, 34, and 35 are threads, 1 to 6 threads are used as the leg elastic 32, 33, 34, and 35, and the threads are spaced from about 0.0625 inch (1.6 mm) to about 0.5 inches (13 mm), more preferably from about 0.0625 inch (1.6 mm) to about 0.25 inch (6 mm), and most preferably about 0.125 inch (3 mm) apart.

The threads may be made of any suitable elastomeric material. One suitable material is spandex such as LYCRA® threads available from DuPont located in Wilmington, Delaware. Suitable leg elastics 32, 33, 34, and 35 include threads having a decitex (g/10000m) of from about 470 to about 1200, more typically from about 620 to about 1000, and most typically from about 740 to about 940 for leg elastics 32, 33, 34, and 35 having comprising from about 3 to about 6 threads. Adhesive 74, typically applied in a meltblown or swirl pattern using currently known technology, is used to bond the leg elastics 32, 33, 34, and 35 to the outer cover 13 and to the body liner 80, the absorbent barrier composite 46, or the leg liner 38. Preferably the adhesive 74 is applied only to the leg elastics 32, 33, 34, and 35. A suitable adhesive includes, for example, Findley H2096 hot melt adhesive which is available from Ato Findley Adhesives located in Milwaukee, WI.

The crotch elastics 37 and 39 are from about 0.0625 inch (1.6 mm) to about 1 inch (25 mm) wide, more typically from about 0.25 inch (6 mm) to about 1 inch (25 mm), and most typically from about 0.25 inch (6 mm) to about 0.75 inch (18 mm) such as 0.5 inch (13 mm). The crotch elastic 37 and 39 is applied under an elongation of from about 100% to about 300%, more typically under

an elongation of from about 150% to about 275%, and most typically under an elongation of from about 200% to about 250%.

5 The crotch elastics 37 and 39 may comprise threads, strands, ribbons, bands, film, elastic nonwovens, or composite. The threads, strands, ribbons, or bands may be multiple and may be applied as a composite. The number of pieces of elastic material comprising the crotch elastic 37 and 39 ranges from about 1 to about 6, more typically from about 2 to about 5, and most typically from about 3 to about 4. Preferably, when the crotch elastics 37 and 39 are threads, 1 to 6 threads are used as the crotch elastics 37 and 39, and the threads are spaced from about 0.0625 inch (1.6 mm) to about 0.5 inches (13 mm), more preferably from about 0.0625 inch (1.6 mm) to about 0.25 inch (6 mm), and most preferably about 0.125 inch (3 mm) apart.

The threads may be made of any suitable elastomeric material. One suitable material is spandex such as LYCRA® threads available from DuPont located in Wilmington, Delaware.

15 Suitable crotch elastics 37 and 39 include threads having a decitex (g/10000m) of from about 470 to about 1200, more typically from about 620 to about 1000, and most typically from about 740 to about 940 for crotch elastics 37 and 39 comprising from about 3 to about 6 threads. Adhesive 74, typically applied in a meltblown or swirl pattern using currently known technology, is used to bond the crotch elastics 37 and 39 to the outer cover 13 and to the absorbent barrier composite 48 or the leg liner 38. Preferably the adhesive 74 is applied only to the crotch elastics 37 and 39. A suitable adhesive includes, for example, Findley H2096 hot melt adhesive which is available from Ato Findley Adhesives located in Milwaukee, WI.

In one embodiment, to provide a snug fit around the leg openings 28 and 30 and to draw up the sides of the crotch portion 18 to form a cradle structure around the absorbent core 50, the leg elastics 32, 33, 34, and 35 are applied to the outer cover 13 under an elongation of about 200% to about 250%. The crotch elastics 37 and 39 are sandwiched between the liquid barrier 48 and the topsheet layer 49 under an elongation of about 200%. Preferably, during the application of the elastics, the front leg elastics 32 and 33 and the back leg elastics 34 and 35 are elongated to a different degree and applied to the outer cover 13. In one embodiment, the front leg elastics 32 and 33 are elongated less than the back leg elastics 34 and 35.

In another embodiment providing a snug fit around the leg openings 28 and 30 and drawing the sides of the crotch portion 18 up to form a cradle structure around the absorbent core 50, the leg elastics 32, 33, 34, and 35 and the crotch elastics 37 and 39 are applied to the outer cover 13 under an elongation of about 200% to about 250%. Preferably, during the application of the elastics, the front leg elastics 32 and 33 and the back leg elastics 34 and 35 are elongated to a



different degree and applied to the outer cover 13. In one embodiment, the front leg elastics 32 and 33 are elongated less than the back leg elastics 34 and 35.

5 In the embodiments having the three segment elastics surrounding each of the leg openings 28 and 30 (the three segment elastics include front leg elastics 32 and 33, back leg elastics 34 and 35, and crotch elastics 37 and 39), the front leg elastics 32 and 33 and the crotch elastics 37 and 39 are elongated less than the back leg elastics 34 and 35. Preferably, the front leg elastics 32 and 33 and the crotch elastics 37 and 39 are elongated to about 200% and the back leg elastics 34 and 35 are elongated to about 250%. The three segment elastic system and differing tensions  
10 allow better fit, less tightness in the groin area, and less bunching of the crotch portion 18 caused by high leg elastic retraction. The back leg elastics 34 and 35 are under higher elongation to help keep the seat of the underpant 12 from creeping up with movement during use and stabilizes the absorbent core 50 from bunching which causes leakage and an uncomfortable fit of the underpant 12.

15

In the embodiments having three segments of elastics surrounding each of the leg openings 28 and 30, the active portions of the crotch elastics 37 and 39 can overlap with the active portions of the leg elastics 32, 33, 34, and 35 as shown in Figure 1a (showing such a configuration with the crotch elastic 39 and leg elastics 32 and 35). The active portions of the crotch and leg elastics 32,  
20 33, 34, 35, 37, and 39 (as well as the waist elastic 21 and the waist portion elastic 22) is defined as the portion of the elastic that exerts a contractive force on the article 10.

In Figure 1a, another configuration of the three segments of elastics surrounding each of the leg openings 28 and 30 is shown wherein the active portion of the crotch elastic 37 overlaps  
25 the active portion of the leg elastic 34 but does not overlap the active portion of the leg elastic 33. This forms a gap 90 in the elastics surrounding the leg opening 30 in the front body portion 14. The gap 90 can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm).

30

The gap 90 provides a more comfortable fit of the underpant 12 in that binding or chafing that may result from the leg elastics 32 and 33 and the crotch elastics 37 and 39 during use with certain body shapes and sizes and activities may be reduced. In addition, the front lower body portion 42 is smoothed, providing a more discrete underpant 12.

35

Another configuration of the three segments of elastics surrounding each of the leg openings 28 and 30 is shown in Figure 1b wherein the active portion of the crotch elastic 39 overlaps the

active portion of the leg elastic 32 but does not overlap the active portion of the leg elastic 35. This forms a gap 92 in the elastics surrounding the leg opening 28 in the back body portion 15. The gap 92 can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1  
5 inch (25 mm) to about 0.5 inch (13 mm).

The gap 92 provides a more comfortable fit of the underpant 12 in that binding or chafing that may result from the leg elastics 34 and 35 and the crotch elastics 37 and 39 during use with certain body shapes and sizes and activities may be reduced. In addition, the back lower body  
10 portion 43 is smoothed, providing a more discrete underpant 12.

Another configuration of the three segments of elastics surrounding each of the leg openings 28 and 30 is shown in Figure 1b wherein the active portion of the crotch elastic 37 does not overlap the active portion of the leg elastics 33 and 34. This forms gaps 90 and 92 in the elastics  
15 surrounding the leg openings 28 and 30 respectively in the front and back body portions 14 and 15 respectively. The gaps 90 and 92 can each range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm).

20 The gaps 90 and 92 provide a more comfortable fit of the underpant 12 in that binding or chafing that may result from the leg elastics 32, 33, 34, and 35 and the crotch elastics 37 and 39 during use with certain body shapes and sizes and activities may be reduced. In addition, the back lower body portion 43 is smoothed, providing a more discrete underpant 12.

25 In the embodiment having the two segment elastics surrounding (see Figure 2a) the leg openings 28 and 30 (the two segment elastics include front leg elastics 32 and 33, and back leg elastics 34 and 35), the front leg elastics 32 and 33 are elongated less than the back leg elastics 34 and 35. Preferably, the front leg elastics 32 and 33 are elongated to about 200%, and the back leg elastics 34 and 35 are elongated to about 250%. The two segment elastic system and differing  
30 tensions allow better fit, less tightness in the groin area, and less bunching of the crotch portion 18 caused by high leg elastic retraction. The back leg elastics 34 and 35 are under higher elongation to help keep the seat of the underpant 12 from creeping up with movement during use and stabilizes the absorbent core 50 from bunching which causes leakage and an uncomfortable fit of the underpant 12.

35 Another configuration of the three segments of elastics surrounding each of the leg openings 28 and 30 is shown in Figure 1c wherein the active portion of the leg elastic 32 does not overlap the active portion of the leg elastic 35. This forms a gap 102 in the elastic surrounding the

- leg opening 28 at the top of the leg opening 28 in the front body portion 14, back body portion 15, or in both the front and back body portions 14 and 15. The gap 102 can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm).
- 5 The gap 102 provides a more comfortable fit of the underpant 12 in that binding or chafing that may result from the leg elastics 32, 33, 34, and 35 during use with certain body shapes and sizes and activities may be reduced. In addition, the gap 102 provides a more discrete underpant 12 as "panty lines" are eliminated at the top of the wearer's legs.
- 10 In the embodiments having two segments of elastics surrounding each of the leg openings 28 and 30, the active portions of the leg elastics 32 and 33 can overlap with the active portions of the leg elastics 34 and 35 as shown in Figure 2a (showing such a configuration with the leg elastic 32 and leg elastic 35).
- 15 In Figure 2a, another configuration of the two segments of elastics surrounding each of the leg openings 28 and 30 is shown wherein the active portion of the leg elastic 33 does not overlap the active portion of the leg elastic 34. This forms a gap 94 in the elastics surrounding the leg opening 30 in the front body portion 14. The gap 94 can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm).
- 20 The gap 94 provides a more comfortable fit of the underpant 12 in that binding or chafing that may result from the leg elastics 32, 33, 34, and 35 during use with certain body shapes and sizes and activities may be reduced.
- 25 Another configuration of the two segments of elastics surrounding each of the leg openings 28 and 30 is shown in Figure 2a wherein the active portion of the leg elastic 32 does not overlap the active portion of the leg elastic 35. This forms a gap 104 in the elastic surrounding the leg opening 28 at the top of the leg opening 28 in the front body portion 14, back body portion 15, or in both the front and back body portions 14 and 15. The gap 104 can range in size from about 3 inches (76 mm) to about 0.125 inches (3 mm), more typically from about 2 inches (51 mm) to about 0.25 inch (6 mm) and most typically from about 1 inch (25 mm) to about 0.5 inch (13 mm). The gap 104 provides a more comfortable fit of the underpant 12 in that binding or chafing that may result from the leg elastics 32, 33, 34, and 35 during use with certain body shapes and sizes and activities may be reduced. In addition, the gap 104 provides a more discrete underpant 12 as "panty lines" are eliminated at the top of the wearer's legs.
- 30
- 35

In the embodiment having a single segment elastic surrounding (see Figure 3) the leg openings 28 and 30 (the single segment elastic include leg elastics 96 and 98), the leg elastics 96 and 98 are applied under an elongation of from about 100% to about 300%, more typically under an elongation of from about 175% to about 275%, and most typically under an elongation of from about 200% to about 250%.

The waist portion elastic 22 circumferentially surrounding the body portions 14 and 15 of the underpant 12 act independently to conform to the contours of various body types and builds. This provides a smooth, snug, and comfortable fit within a given hip size range. In embodiments having waist elastic 21, the use of higher elongation, closer spacing, and higher cross-sectional area in the waist elastic 21 than in the waist portion elastic 22, results in the underpant 12 having a rounded shape and good waist fit across a wide range the waist to hip ratios encountered. The elongation of the waist portion elastic 22 can be different in the front and back body portions 14 and 15.

Preferably, in the front body portion 14, the waist portion elastic 22 are spaced apart from the front leg elastics 32 and 33. The waist portion elastics 22 in the back body portion 15 are spaced apart from the back leg elastics 34 and 35. The distance between the waist portion elastic 22 and the leg elastics 32, 33, 34, and 35 may range from about 0.125 inch (3 mm) to about 3 inches (76 mm), more typically from about 0.25 inch (6 mm) to about 2 inches (51 mm), and more typically from about 0.25 inch (6 mm) to about 1.5 inches (38 mm). The spacing in the front body portions 14 and 15 are not required to be the same size. However, the waist portion elastic 22 in either or both of the front and back body portions may be adjoin the front or back leg elastics 32, 33, 34, and 35 respectively. In embodiments where waist elastic 21 are present, it is preferable that the waist portion elastic 22 are spaced apart from the waist elastic 21 and the leg elastics 32, 33, 34, and 35.

However, the waist portion elastic 22 in either or both of the front and back body portions may adjoin either or both the waist elastic 21 and the leg elastics 32, 33, 34, and 35 wherein the waist portion elastic 22 adjoin at least a portion of the leg elastics 32, 33, 34, and 35. In a underpant 12 which is sized to comfortably fit a hip range from about 36 inches (914 mm) to about 45 inches (1143 mm), the waist portion elastic 22 are about 4 inches (102 mm) wide in the front body portion 14 and about 6.25 inches (159 mm) wide in the back body portion 15. The waist portion elastic 22 may be spaced from about 0.0625 inch (1.6 mm) to about 0.5 inch (13 mm) apart. Preferably, the waist portion elastic 22 are spaced from 0.0625 inch (1.6 mm) to about 0.25 inch (6 mm) apart. Most preferably, the waist portion elastic 22 are spaced about 0.125 inch (3 mm) apart.

The absorbent barrier composite 46 which extends up the front and/or back body portions 14 and 15 toward the waist opening 20 is conformed to the wearer's body by the force exerted by the waist portion elastic 22. The transition from the front and back lower body portions 42 and 43 to the front and back upper body portions 40 and 41 is thus smoothed.

In embodiments having waist elastic 21, it is desirable that the waist elastic 21 are under a greater tension per unit width than the waist portion elastic 22 in the upper body portions 40 and 41 to provide the snug waist fit over the range of waist to hip ratios of the various body shapes. In the preferred embodiment, the tension on the waist elastic 21 is coordinated with the tension of the waist portion elastic 22 to form a snug fit about the waist opening 20 while providing a smooth transition from the upper body portions 40 and 41 to the front and back waist edge portions 44 and 45. However, the tensions and the LYCRA® counts of the waist elastic 21 and the waist portion elastic 22 can be different.

In the front and back body portions 14 and 15, the leg liner 38, the waist liner 26, and /or the topsheet layer 49 may be expanded to cover the interior of the body portions 14 and 15. In another embodiment, the leg liner 38, the waist liner 26, and/or the topsheet layer 49 may exclude the center crotch portion 18 which is covered by the application of the absorbent barrier composite 46. In the body portions 14 and 15 where the absorbent barrier composite 46 overlaps the liner 80, the composite 46 is applied on top of any liner 80 present so as to contact the wearer. However, the overlapping portion of the absorbent barrier composite 46 may be sandwiched between the outer cover 13 and the body liner 80.

For embodiments having waist portion elastic 22, leg elastics 32, 33, 34, and 35, and crotch elastics 37 and 39, the following ranges for the tensions of the elastics 22, 32, 33, 34, 35, 37, and 39 are provided in TABLE I below.

TABLE I

	Acceptable Range		More Acceptable Range		Most Acceptable Range	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Waist Elastic 22	10 grams	150 grams	30 grams	100 grams	45 grams	75 grams
Leg Elastics 32, 33, 34, and 35	20 grams	400 grams	80 grams	220 grams	120 grams	180 grams
Crotch Elastics 37 and 39	20 grams	400 grams	80 grams	220 grams	120 grams	180 grams

5

For embodiments having waist elastic 21, waist portion elastic 22, leg elastics 32, 33, 34, and 35, and crotch elastics 37 and 39, the following ranges for the tensions of the elastics 21, 22, 32, 33, 34, 35, 37, and 39 are provided in TABLE II below.

10

TABLE II

	Acceptable Range		More Acceptable Range		Most Acceptable Range	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Waist Elastic 21	30 grams	300 grams	50 grams	200 grams	100 grams	175 grams
Waist Elastic 22	10 grams	150 grams	20 grams	100 grams	40 grams	80 grams
Leg Elastics 32, 33, 34, and 35	20 grams	400 grams	80 grams	220 grams	120 grams	180 grams
Crotch Elastics 37 and 39	20 grams	400 grams	80 grams	220 grams	120 grams	180 grams

15

The tensions of the waist elastic 21, waist portion elastic 22, crotch elastics 37 and 39, and leg elastics 32, 33, 34, and 35 were determined as follows. Samples having the dimensions of 10 mm wide and 51 mm in length were tested for each of the elastics 21, 22, 32, 33, 34, and 35. The tensions stated in TABLE I and TABLE II are given in grams per a 10 mm width. If the size of the sample being tested varies from a 10 mm width, the values must be normalized to a 10 mm width. The tensions were measured during the first cycle extension at 100 percent elongation at room temperature and humidity.

10        The side seams 64 and 70 may be made on the inside or outside of the underpant 12 or formed flat against the underpant 12 to give a more finished look to the underpant 12 and to prevent the side seams 64 and 70 from showing through clothing. Optionally, the lateral edges 60, 62, 66 and 68 of the front and back body portions are not overlapped but are formed flat and extend out laterally. The side seams 64 and 70 should be minimal in width while providing  
15        sufficient strength to be pulled up and down many times over a 24 hour wear period without tearing or breaking. Suitable side seams and seals are described in U.S. Patents 4,610,681 issued September 9, 1986, to Strohsen et al., 4,641,381 issued February 10, 1987 to Heran et al., and 4,646,362 issued March 3, 1987 to Heran et al. which are incorporated herein by reference.

20        The side seams 64 and 70, respectively, of the outer cover 13 are sealed by means known in the art, such as ultrasonic bonding, stitching heat/pressure bonding or adhesive bonding. The maximum seam strength attainable is dependent upon materials used, bond pattern, bond width, and process settings of dwell time, power, and pressure. Suitable side seams typically utilize ultrasonic bonding to achieve a seam strength such that the side seams 64 and 70 do not tear or  
25        open during use.

      The side seams 64 and 70 may have an unbonded portion outboard of the bonded area to provide for a soft edge to each of the side seams 64 and 70. This unbonded portion can range from about 0 to about 13 mm in width, more preferably from about 1 to about 6 mm in width and  
30        most preferably from about 2 to about 3 mm in width. Alternatively, the entire seam width (bonded portion plus unbonded portion) may be less than about 0.6 inch (15 mm). If the seam is trimmed or cut close to the outer edge of the bond area, a sharp edge is produced along the seam edge which can catch on clothes or be irritating to the wearer's skin.

35        Having thus described the invention in full detail, it will be readily apparent that various changes and modifications may be made without departing from the spirit of the invention. All such changes and modification are contemplated as being within the scope of the present invention, as defined by the following claims.

We Claim:

- 1.** A disposable underpant comprising:
  - a) an outer cover having front and back body portions connected by a crotch portion, said front and back body portions connected together to form a waist opening and two leg openings;
  - b) an absorbent barrier composite associated with said crotch portion having a liquid impervious layer, a pervious layer, and an absorbent core; and,
  - c) said outer cover includes front leg elastic, back leg elastic, and crotch elastic positioned around each of said leg openings to form a gather around each said leg opening, waist portion elastic positioned around said positioned around said front and back body portions to form a gather of said front and back body portions.
- 2.** The disposable underpant of Claim 1 wherein said absorbent barrier composite is essentially coterminous with the edge of the crotch portion.
- 3.** The disposable underpant of Claim 1 wherein said absorbent core consists of: pulp; super absorbent material; meltblown fibers; adhesives; stabilizers; nonabsorbent fibers; foams; and, mixtures thereof.
- 4.** The disposable underpant of Claim 2 wherein said absorbent core is selected from the group consisting of: pulp; super absorbent material; meltblown fibers; adhesives; stabilizers; nonabsorbent fibers; foams; and, mixtures thereof.
- 5.** The disposable underpant of Claim 1 wherein said absorbent barrier composite covers a portion of said front and back body portions.
- 6.** The disposable underpant of Claim 1 wherein said absorbent core has a total absorbent capacity of at least 100 grams.



- 7.** The disposable underpant of Claim 5 wherein said absorbent core has a total absorbent capacity of at least 100 grams.
- 8.** The disposable underpant of Claim 6 wherein said absorbent core has a total absorbent capacity of from about 100 grams to about 1500 grams.
- 9.** The disposable underpant of Claim 1 wherein said front leg elastics, back leg elastics, crotch elastics, waist portion elastic are adhered to the disposable underpant by an adhesive that is applied directly to said elastics.
- 10.** The disposable underpant of Claim 1 wherein each leg opening comprises a back portion having a back edge and each said back edge is essentially linear and forms from about a 55° angle to about a 87° angle with the longitudinal centerline of said underpant.
- 11.** The disposable underpant of Claim 1 wherein each leg opening comprises a front portion having a front edge and each said front edge is essentially linear and forms from about a 62° angle to about a 99° angle with a longitudinal centerline of said disposable underpant.
- 12.** The disposable underpant of Claim 10 wherein each leg opening comprises a front portion having a front edge and each said front edge is essentially linear and forms from about a 62° angle to about a 99° angle with a longitudinal centerline of said disposable underpant.
- 13.** The disposable underpant of Claim 1 further comprising waist elastic positioned around said waist opening to form a gather around said waist opening.
- 14.** The disposable underpant of Claim 12 further comprising waist elastic positioned around said waist opening to form a gather around said waist opening.
- 15.** The disposable underpant of Claim 13 wherein said waist elastic has a tension which is greater than the tension per unit width in said waist portion elastic.

- 16.** The disposable underpant of Claim 14 wherein said waist elastic has a tension which is greater than the tension per unit width in said waist portion elastic.
- 17.** The disposable underpant of Claim 15 wherein said back leg elastic has a tension which is greater than the tension per unit width in the said crotch elastic or front leg elastic.
- 18.** The disposable underpant of Claim 16 wherein said back leg elastic has a tension which is greater than the tension per unit width in the said crotch elastic or front leg elastic.
- 19.** The disposable underpant of Claim 17 wherein said waist portion elastic about said disposable underpant extends from said waist opening to said leg openings.
- 20.** The disposable underpant of Claim 18 wherein said waist portion elastic about said disposable underpant extends from said waist opening to said leg openings.
- 21.** The disposable underpant of Claim 17 wherein said waist portion elastic about said disposable underpant extends from said waist opening and is separated from the leg elastic by a space of at least 0.25 inch.
- 22.** The disposable underpant of Claim 18 wherein said waist portion elastic about said disposable underpant extends from said waist opening and is separated from the leg elastic by a space of at least 0.25 inch.
- 23.** The disposable underpant of Claim 22 wherein said front leg elastic and crotch elastic around each leg opening defines a gap between said front leg elastic and said crotch elastic.
- 24.** The disposable underpant of Claim 22 wherein said back leg elastic and crotch elastic around each leg opening defines a gap between said back leg elastic and said crotch elastic.
- 25.** The disposable underpant of Claim 23 wherein said back leg elastic and crotch elastic around each leg opening defines a gap between said back leg elastic and said crotch elastic.

**26.** The disposable underpant of Claim 18 wherein said front leg elastics comprise multiple individual elastic threads, said back leg elastics comprise multiple individual elastic threads, and said waist portion elastics comprise multiple individual elastic threads, said leg and waist portion elastics threads being spaced from about 1 mm to about 13 mm apart.

**27.** The disposable underpant of Claim 1 wherein said crotch portion is wider than said absorbent core.

**28.** The disposable underpant of Claim 28 wherein width of said crotch portion is sized to be at least about 6 mm wider than the width of said absorbent core.

**29.** The disposable underpant of Claim 28 wherein said crotch portion is at least about 102 mm in width.

**30.** A disposable underpant comprising:

- a) an outer cover having front and back body portions connected by a crotch portion, said front and back body portions connected together to form a waist opening and two leg openings wherein each leg opening comprises a front portion having a front edge and a back portion having a back edge;
- b) an absorbent barrier composite associated with said crotch portion having a liquid impervious layer, a pervious layer, and an absorbent core;
- c) a majority of the length of said back edge of said back portion of each said leg opening is linear, said linear portion forming an angle with a longitudinal centerline A-A of said underpant of from about 55° to about 87°; and,
- d) a majority of the length of said front edge of said front portion of each said leg opening is linear, said linear portion forming an angle with a longitudinal centerline A-A of said underpant of from about 82° to about 99°.

- 31.** The disposable underpant of Claim 30 further comprising said outer cover includes front leg elastic, back leg elastic, and crotch elastic positioned around each of said leg openings to form a gather around each said leg opening, waist portion elastic positioned around said positioned around said front and back body portions to form a gather of said front and back body portions.
- 32.** The disposable underpant of Claim 31 further comprising waist elastic positioned around said waist opening to form a gather around said waist opening.
- 33.** The disposable underpant of Claim 32 wherein said waist elastic has a tension which is greater than the tension per unit width in said waist portion elastic.
- 34.** The disposable underpant of Claim 33 wherein said back leg elastic has a tension which is greater than the tension per unit width in the said crotch elastic or front leg elastic.
- 35.** The disposable underpant of Claim 34 wherein said waist portion elastic about said disposable underpant extends from said waist opening to said leg openings.
- 36.** The disposable underpant of Claim 34 wherein said waist portion elastic about said disposable underpant extends from said waist opening and is separated from the leg elastic by a space of at least 0.25 inch.
- 37.** The disposable underpant of Claim 32 wherein said front leg elastic and crotch elastic around each leg opening defines a gap between said front leg elastic and said crotch elastic.
- 38.** The disposable underpant of Claim 32 wherein said back leg elastic and crotch elastic around each leg opening defines a gap between said back leg elastic and said crotch elastic.
- 39.** The disposable underpant of Claim 37 wherein said back leg elastic and crotch elastic around each leg opening defines a gap between said back leg elastic and said crotch elastic.
- 40.** The disposable underpant of Claim 30 wherein said front leg elastics comprise multiple individual elastic threads, said back leg elastics comprise multiple individual elastic threads, and

said waist portion elastics comprise multiple individual elastic threads, said leg and waist portion elastics threads being spaced from about 1 mm to about 13 mm apart.

**41.** The disposable underpant of Claim 30 wherein said crotch portion is wider than said absorbent core.

**42.** The disposable underpant of Claim 41 wherein width of said crotch portion is sized to be at least about 6 mm wider than the width of said absorbent core.

**43.** The disposable underpant of Claim 41 wherein said crotch portion is at least about 102 mm in width.

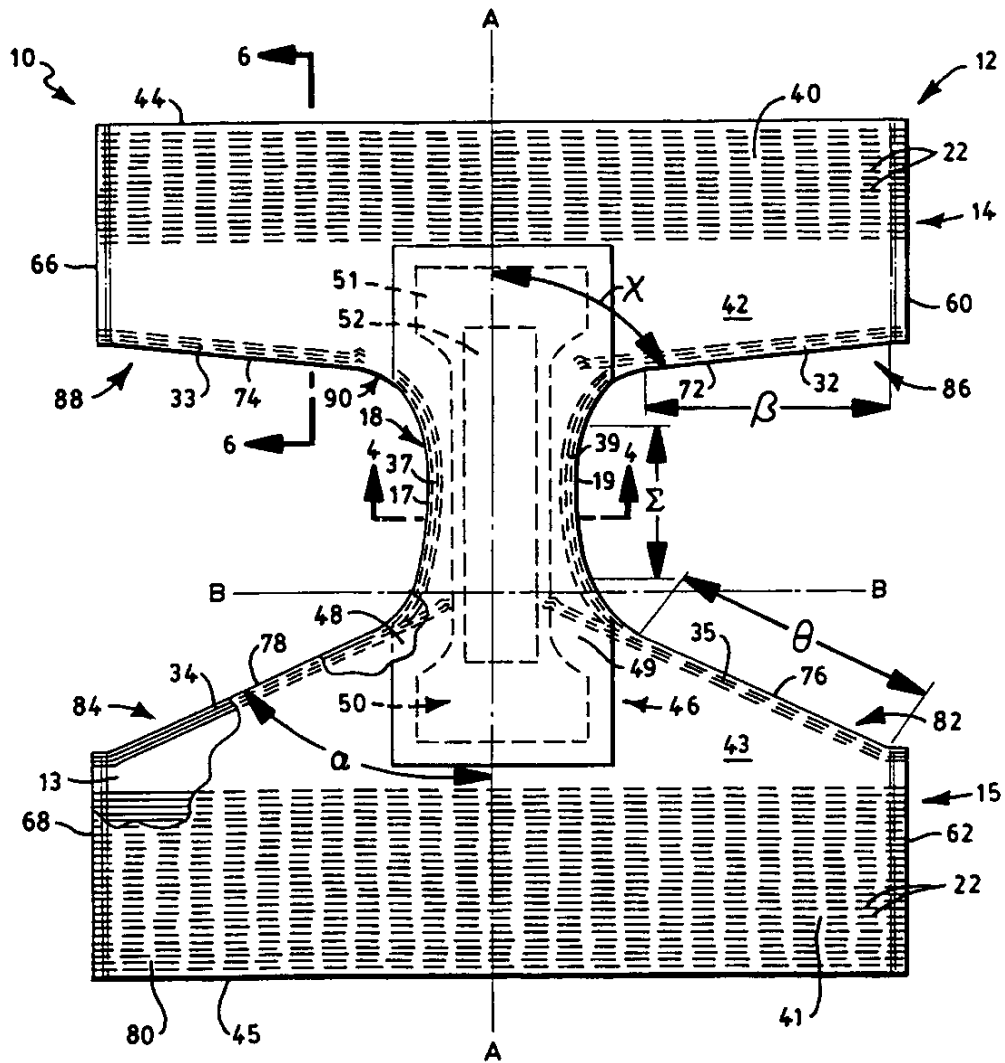


FIG. 1a

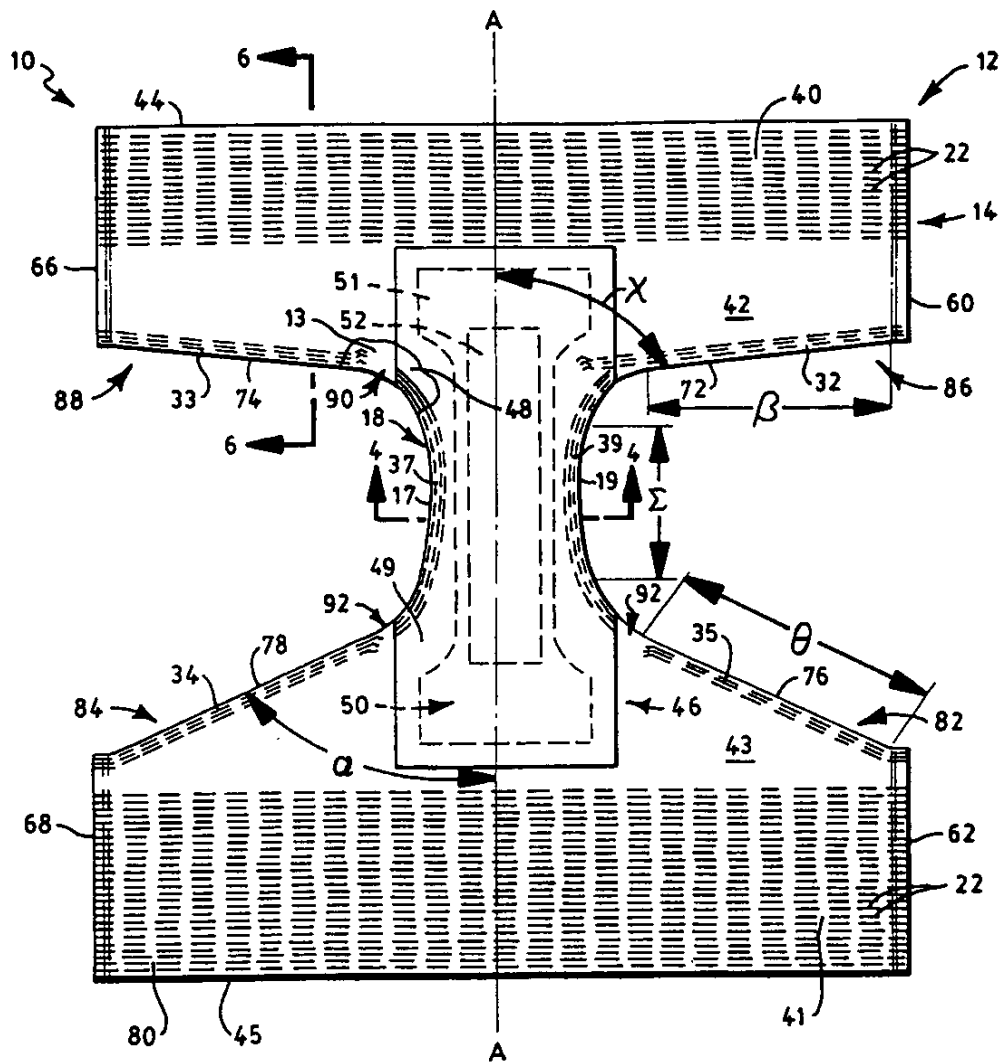


FIG. 1b

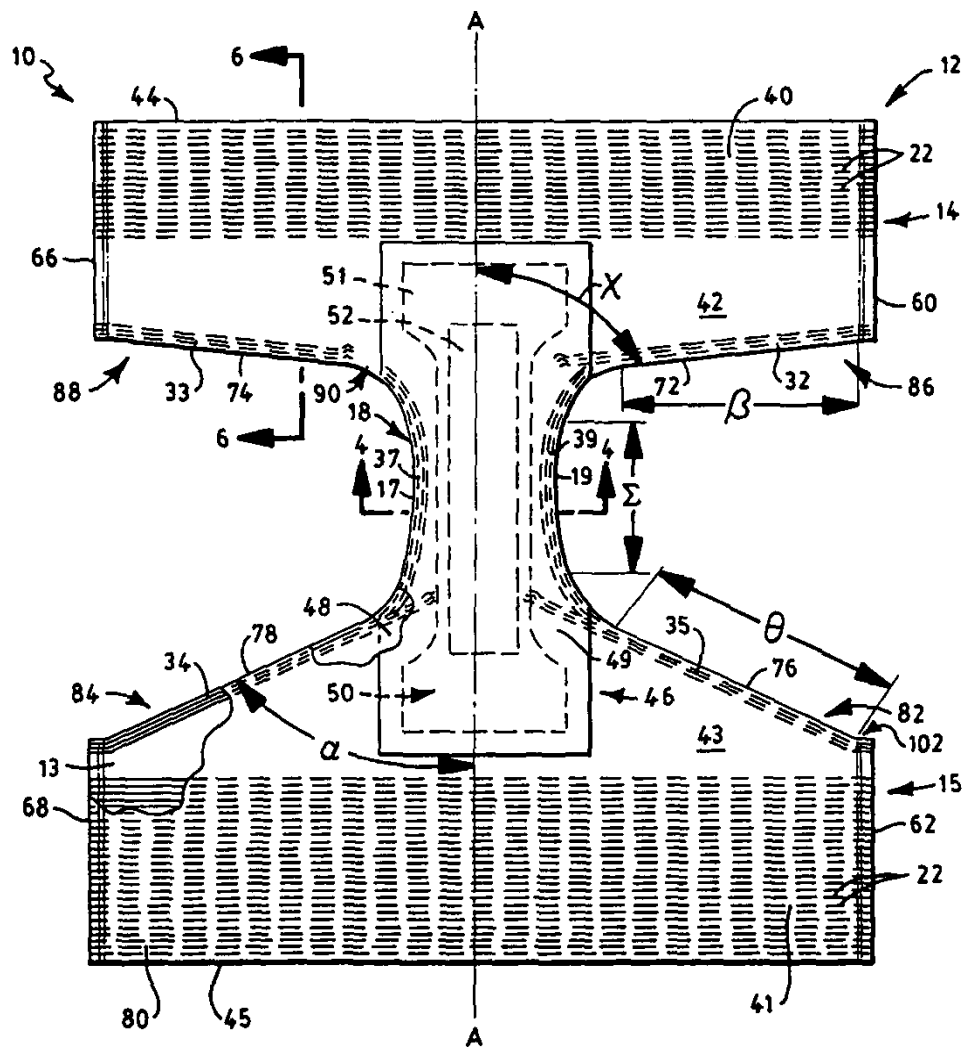


FIG. 1c



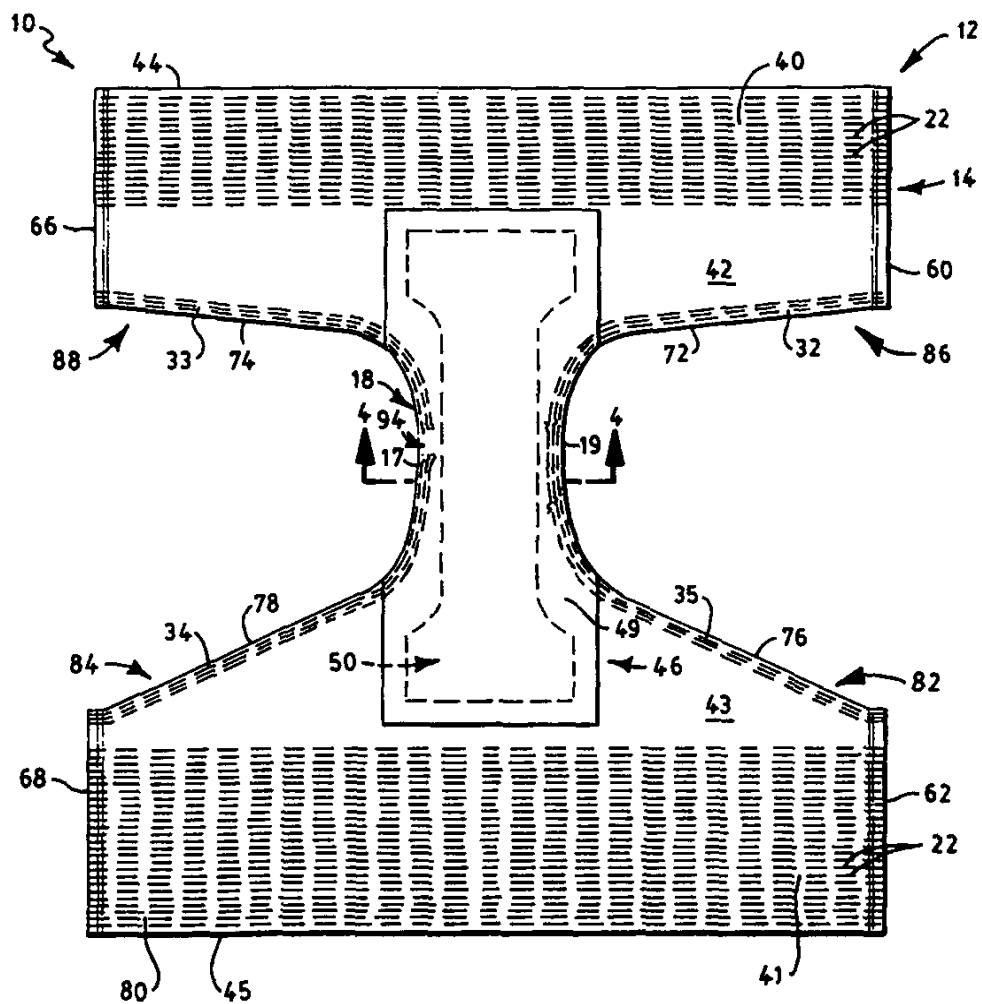


FIG. 2a

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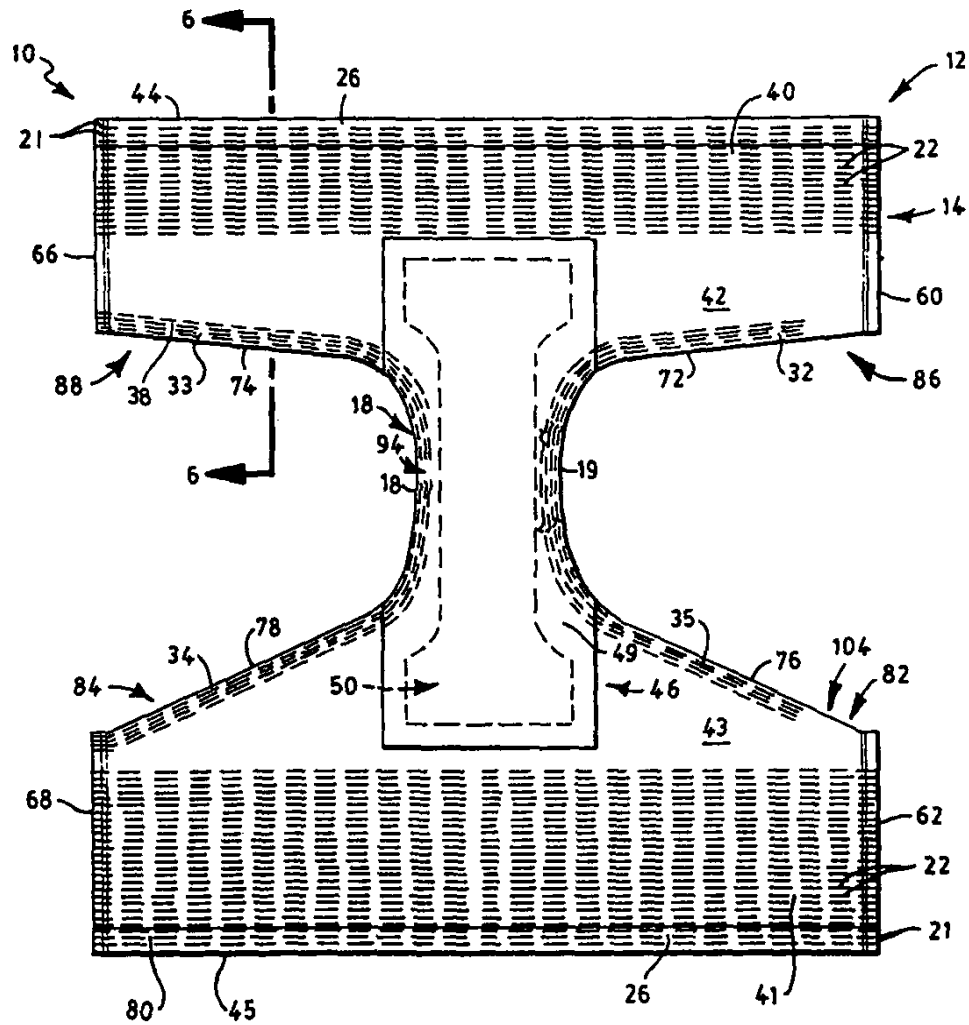


FIG. 2b



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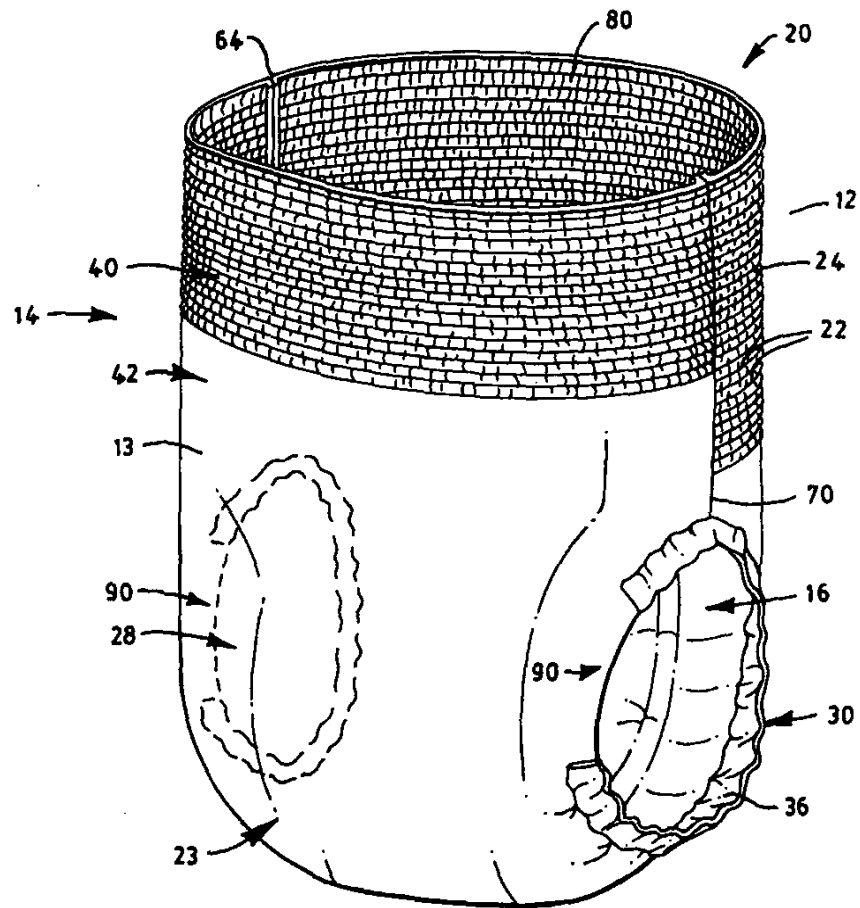


FIG. 4

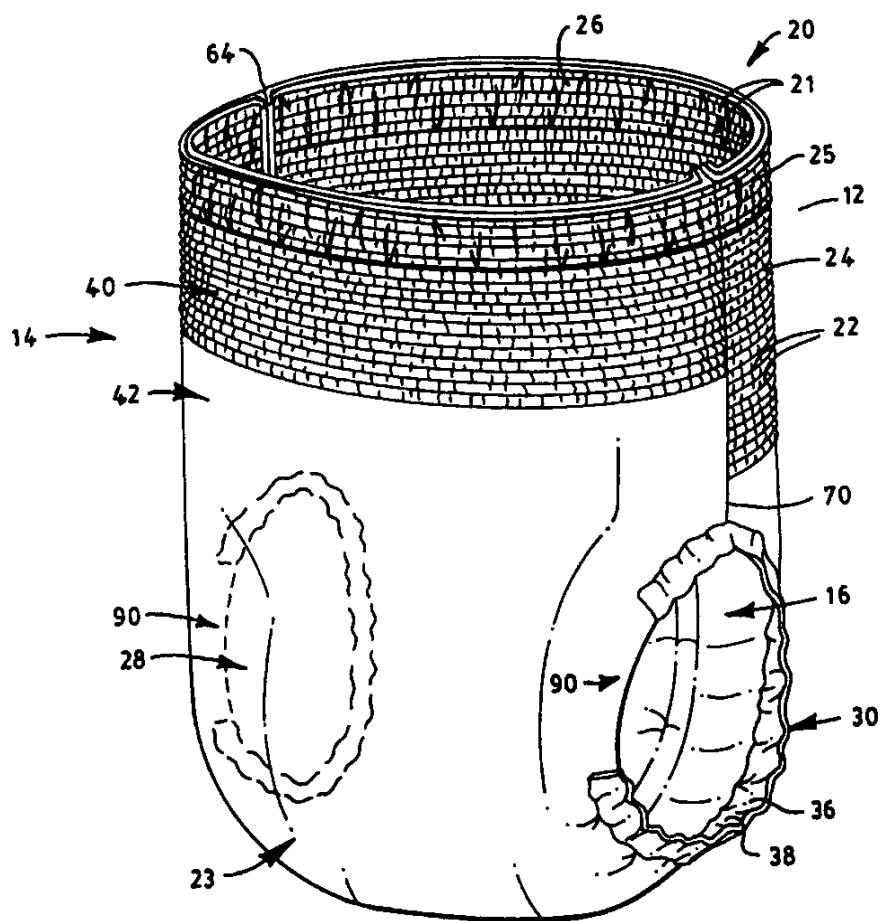


FIG. 5

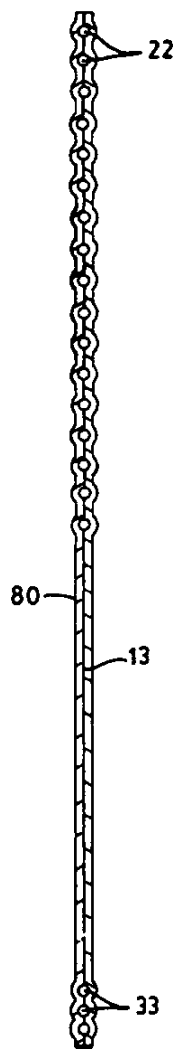


FIG. 6

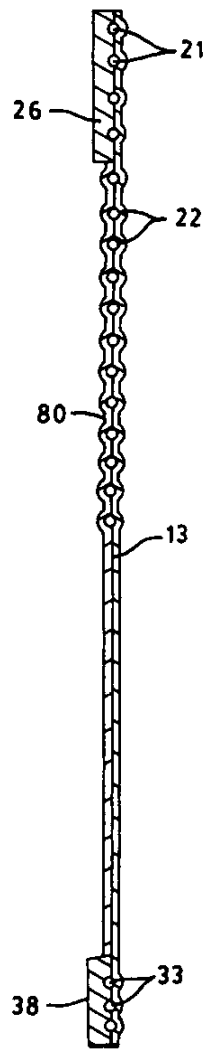


FIG. 7

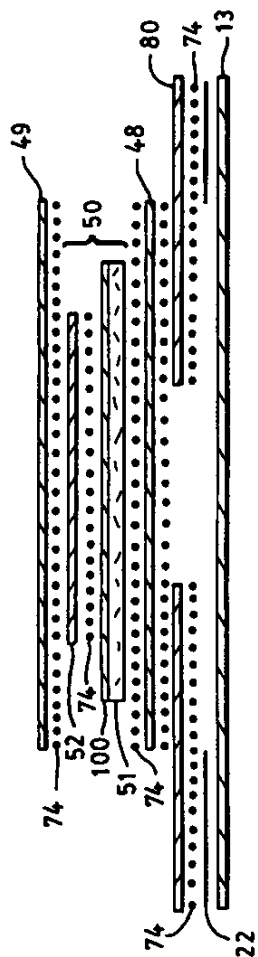


FIG. 8

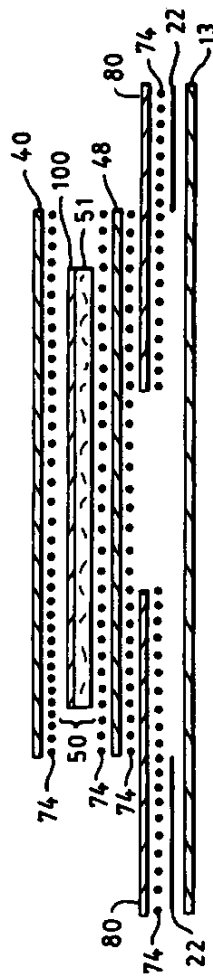


FIG. 9

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 98/24544

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 A61F13/15

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 074 854 A (DAVIS KAREN M) 24 December 1991  see page 3, line 22 - line 28; figures see page 6, line 51 - line 68 see page 8, line 57 - page 9, line 4; claims 8,9,13	1-5, 10-14, 30-32
X	GB 2 253 131 A (KAO CORP) 2 September 1992  see page 7, line 23 - page 9, line 29; claims; figures	1,3,5, 10,13,27
A		4,11,14, 21,26, 30-32, 36,40,41
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

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Date of the actual completion of the international search

19 March 1999

Date of mailing of the international search report

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# INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 98/24544

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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